

Application No.: 10/678,766
Filing Date: October 2, 2003

REMARKS

Claims 1, 3-24 and 26-44 are pending in the present application. Claims 1, 22, 24 and 36 have been amended. Claims 40-41 have been added. Support for the new and amended claims can be found in the Application as originally filed, for example, on pages 9-12. Thus, no new matter has been added.

Rejection Under 35 U.S.C. 103

Claims 1, 3-9, 11-24 and 26-39 have been rejected as obvious over George et al. (“Surface Chemistry for Atomic Layer Growth”) in view of Sandhu et al. (U.S. Patent No. 6,313,035), Leskela et al. (*Journal De Physique IV*) and Suntola et al. (U.S. Patent Nos. 6,015,590). Claim 10 has been rejected as unpatentable over George et al., in view of Sandhu et al., Leskela et al. and Suntola et al. as applied to the claims above, and further in view of Lowrey et al. (U.S. Patent No. 5,891,744). These rejections are respectfully traversed and Applicants submit the following.

i. The cited references fail to teach or suggest all the claim limitations

In order to establish a *prima facie case* of obviousness, the references must teach or suggest all of the claim limitations. *See M.P.E.P. § 2142.* Applicants submit that the cited art fails to teach or suggest the combinations recited in Claims 1, 22, 24 and 36 as amended.

Applicants continue to disagree with the Examiner’s rejections and remarks as set forth in the Office Action. However, to help facilitate prosecution Applicants have amended independent Claims 1, 22, 24 and 36 to recite methods and ALD processes in “a flow type reactor.” This feature is not taught by or suggested in the cited art. To further emphasize the distinctions provided by a “flow type reactor” in the claimed combinations, Applicants refer to the Declaration of inventor Suvi Haukka, submitted herewith.

Applicants submit that the primary reference George et al. fails to disclose a “flow type reactor” but rather, only indicates use of a ‘backfill’ reactor. (*See* paragraph 7 of the Declaration of Suvi Haukka). Applicants submit that there is no reason to modify the process of George et al. to utilize a “flow type reactor,” as explained in paragraphs 7-8 of the Declaration. Further, Applicants have found no appreciable growth of the silicon dioxide films in a “flow type

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reactor,” as reported in paragraph 9 of the Declaration. Thus, there would not have been a reason to attempt to deposit metal silicon oxide films by modifying George et al. or any expectation of success in such a modification.

Because the cited references fail to teach or suggest the claimed combinations recited in independent Claims 1, 22, 24 and 36 as amended, Applicants submit that a *prima facie* case of obviousness has not been established.

ii. Unexpected Results

Applicants maintain that the unexpected results of the present invention rebut any *prima facie* case of obviousness. *See In re Soni*, 54 F.3d 746 (Fed. Cir. 1995). Specifically, Applicants maintain that ALD growth of metal silicon oxides by the claimed methods was a result that was unexpected to the inventors and would not have been expected by the skilled artisan. (*See* paragraphs 8–17 of the Declaration of Suvi Haukka).

In response to Applicants’ previous arguments regarding Applicants’ unexpected results, on page 10 of the Final Office Action of November 18, 2008 and in the Interview Summary mailed February 4, 2009, the Examiner points out that George et al. teaches ALD growth rates of silicon dioxide (1.1 Å/AB cycle) equal to the surprisingly high growth rates of metal silicon oxides reported by Applicants. However, Applicants submit that the growth rates disclosed in George et al. can be distinguished because the process of George et al. requires very long precursor exposure times and were not obtained in a “flow type reactor” as recited in the amended claims. For example, George et al. shows exposure times of SiCl₄ and H₂O for as long as 72 minutes. (*See* George et al., page 13123). As discussed in paragraphs 5-6 of the Declaration, Applicants submit that the long precursor exposure times disclosed in George et al. are obtained through the use of a ‘backfill reactor’ in which the exhaust is closed and reactants are allowed to soak on a substrate over long periods of times. Thus, Applicants submit that the growth rate of SiO₂ in George et al. is not relevant to Applicants’ unexpected results because George et al. fails to disclose its reported film growth rates in a “flow type reactor” as now explicitly recited in the amended claims.

Moreover, Applicants submit that the skilled artisan would not have expected the process of forming SiO₂ as disclosed in George et al. to even work in a “flow type reactor,” and that

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indeed, the inventors have experimentally found that SiO_2 does not grow appreciably in a “flow type reactor.” (See paragraphs 7-9 of the Declaration of Suvi Haukka). Applicants also refer to the low growth rates for other metal oxides in a flow type reactor observed by the inventors. (See paragraph 10 of the Declaration). In view of the minimal or low growth rates for SiO_2 and metal oxides in a flow type reactor, the growth rates of metal silicon oxides were not only unexpectedly high, but considerably ***higher*** than the sum of the growth rates of each individual metal oxide and silicon oxide from which the metal silicon oxide is formed. (See paragraphs 13-15 of Declaration). This result was surprising, because the skilled artisan would ***not*** have expected the growth rate of the claimed metal silicon oxide to be ***any higher*** than the sum of growth rates of each corresponding metal oxide and silicon oxide ***combined***. Applicants submit that only the inventors have recognized the surprising result that while SiO_2 grows surprisingly well on a metal oxide surface in a “flow type reactor” in the manner recited in the claims such that the metal silicon oxide has an unexpectedly high growth rate.

The Examiner also alleges on page 10 of the Final Office Action that because Example 2 fails to disclose deposition conditions for the growth rates of the different oxides, “no accurate comparison can be made.” Specifically, the Examiner notes that the Application (on page 11) discloses a SiO_2 growth rate of .15 Å/cycle for a temperature of 300°C, and a SiO_2 growth rate of .28 Å/cycle for a temperature of 200°C. In response, Applicants note that the difference between the above growth rates is small compared to the difference between SiO_2 growth at either temperature compared to the growth rates of metal silicon oxides. Example 2 discloses (with the exception of the last outlier) growth rates that are considerably higher than the growth rate of the SiO_2 of Example 1 formed by ***both*** temperatures of 200°C and 300°C. Applicants further refer to paragraphs 10–14 of the Declaration that report that the growth rate of the metal silicon oxides were considerably higher than the growth rates of SiO_2 . Thus, Applicants submit that the different SiO_2 growth rates caused by the different temperatures ***do not*** change the conclusion that the growth rates of the metal silicon oxides were found to be surprisingly higher than that of SiO_2 (at different temperatures).

Regarding Applicants’ unexpected results, the Examiner alleges on pages 9-10 of the Final Office Action that the claims are too broad and not commensurate in scope with the evidence. Applicants disagree and submit that all the different metal silicon oxides tested and

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reported in the Application showing an unexpected increase in growth rate over that of each individual corresponding oxide is a sufficient sampling for the skilled artisan to reasonably conclude that the phenomenon is applicable to all metal silicon oxides over their respective individual oxides. (*See Declaration, paragraph 17*). The Examiner has provided no technical evidence or reasoning to question this conclusion.

Finally, the Examiner notes on page 10 off the Office Action that the self-terminating nature of ALD methods requires that complete half reactions occur, and that George et al. teaches complete half reactions with a maximum growth rate of approximately 1.1 Å/cycle. The Examiner suggests that Applicants' methods are deficient for supposedly only teaching incomplete half reactions with a growth rate of .2 Å/cycle. Applicants disagree. As described in paragraph 18 of the Declaration, Applicants submit that ALD processes produce different film growth rates depending on various factors, such as the particular chemical precursors used, the density of reactive sites, and the stereochemical limits on the depositing surface. As discussed in paragraph 18 of the Declaration, Applicants submit that the growth rate of .2 Å/cycle for SiO₂ as reported in the Application reflects that of complete, saturated reactions.

Thus, Applicants maintain that the unexpected results of ALD of a metal silicon oxide in a "flow type reactor" as set forth in the Application rebut any *prima facie* case of obviousness.

iii. A Reason to Combine the References Has Not Been Provided

Applicants continue to maintain that the Examiner has failed to establish a *prima facie* case of obviousness, because the Examiner has not "articulated reasoning with some rational underpinning" to combine the references, as required by the Supreme Court in *KSR International Co. v. Teleflex Inc.*, 550 U.S. ____ (2007).

On page 9 of the Office Action, the Examiner concedes that there must be reason to combine the references to establish obviousness, but proceeds to only allege that it would have been obvious to combine the teachings of George et al. and Sandhu et al. with Leskela et al without providing *any specific reason* for the combination. Applicants submit that the mere fact that Sandhu et al. teaches *a multicomponent film* considered 'useful' is not a sufficient reason to modify *the method of producing* such a multicomponent film, from the CVD methods taught by

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Sandhu et al. to the ALD methods of George et al. or Leskela et al., given the differences between CVD and ALD processes.

Applicants maintain that the Examiner errs in assuming that producing a multicomponent film by the claimed ALD methods would have been obvious or automatic, with no consideration that the skilled artisan would find the modification *even possible*. For example, the skilled artisan would appreciate that CVD processes work on very different principles from ALD and therefore are *not interchangeable* with ALD processes. There is no reason to believe that producing the multicomponent films disclosed in Sandhu et al. could *even work* by ALD. As discussed in the Declaration, appreciable SiO₂ growth was not obtained in flow type reactors. Thus, it is not a foregone conclusion that a CVD reaction can be adapted for ALD.

Applicants further maintain that the Examiner errs in assuming that producing a multicomponent film by the claimed ALD methods would have been obvious, with no consideration for why the costs and disadvantages to such modifications would even be acceptable. The skilled artisan would recognize that because films are grown monolayer by monolayer using ALD, they have reduced throughput with a corresponding increased cost. Thus, without any reason to utilize ALD, the skilled artisan would select a process with a higher throughput to form a multicomponent film. There is no suggestion in the cited art that the multicomponent film of Sandhu et al. formed by CVD are deficient in some way such that they would benefit from deposition by the ALD methods of George et al. or Leskela et al.

Thus, Applicants maintain that the Examiner *must provide some reasoning*, technical or otherwise, to explain why the skilled artisan would even believe ALD methods of producing the multicomponent oxide of Sandhu et al. to be *even possible*, and further worth the increased costs over more efficient deposition methods such as the CVD methods of Sandhu et al.

Accordingly, Applicants maintain that the Examiner has failed to establish a *prima facie* case of obviousness.

For at least the forgoing, Applicants respectfully request withdrawal of the rejections to Claims 1, 22, 24 and 36 and the claims that depend therefrom.

New Claims

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Applicants submit that the cited references fail to teach or suggest an ALD process for producing a thin metal silicon oxide film on a substrate in the manner recited in Claim 1, “wherein the ratio of silicon compound contacting steps to metal compound contacting steps during the ALD process is two to one” as recited in new Claim 40. Applicants reiterate that the Examiner has articulated no reason to combine the cited references to form a metal silicon oxide film in the manner claimed, and further that the results of forming metal silicon oxide films by ALD in a flow type reactor were unexpected. In addition, Applicants submit that there is no teaching or suggestion to modify the teachings of the art further such that the ratio of silicon compound contacting steps to metal compound contacting steps is two to one. Thus, Applicants respectfully submit that Claim 40 is allowable.

Applicants submit that the cited references fail to teach or suggest an ALD process for producing a thin metal silicon oxide film “wherein the metal silicon oxide film is stoichiometric” as recited in new Claim 41. Specifically, Applicants maintain that the disclosure in C5-946 of Leskela et al. that “[t]he growth of ternary oxides by ALE is a challenge” *teaches away* from the claimed invention and specifically from the combination recited in independent Claim 22.

The Examiner notes on page 9 of the Office Action that Leskela et al. teaches “the achievement of *correct* stoichiometry is more difficult, not that ternary oxide growth in general is more difficult” (emphasis added). Applicants maintain that the mere statement in Leskela et al. that achieving specifically “*correct* stoichiometry” is difficult does not render meaningless the explicit teaching in Leskela et al. that “[t]he growth of ternary oxides by ALE is a challenge.” In view of the Examiner’s own admission that Leskela et al. teaches that achieving correct stoichiometry in ternary oxide growth is “more difficult,” Applicants submit that Leskela *teaches away* from ALD of a thin metal silicon oxide film “wherein the metal silicon oxide film is stoichiometric,” as recited in Claim 41.

For at least the forgoing, Applicants respectfully submit that new Claims 40-44 are in condition for allowance.

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No Disclaimers or Disavowals

Although the present communication may include alterations to the application or claims, or characterizations of claim scope or referenced art, Applicant is not conceding in this application that previously pending claims are not patentable over the cited references. Rather, any alterations or characterizations are being made to facilitate expeditious prosecution of this application. Applicant reserves the right to pursue at a later date any previously pending or other broader or narrower claims that capture any subject matter supported by the present disclosure, including subject matter found to be specifically disclaimed herein or by any prior prosecution. Accordingly, reviewers of this or any parent, child or related prosecution history shall not reasonably infer that Applicant has made any disclaimers or disavowals of any subject matter supported by the present application.

Co-Pending Applications of Assignee

Applicant wishes to draw the Examiner's attention to the following co-pending applications of the present application's assignee.

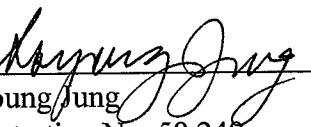
Docket No.	Serial No.	Title	Filed
SEPP21.001APC	10/148525	METHOD OF GROWING OXIDE FILMS	08/27/02
SEPP21.001C2	11/615827	METHOD OF GROWING OXIDE FILMS	12/22/06

Please charge any additional fees, including any fees for additional extension of time, or credit overpayment to Deposit Account No. 11-1410.

Respectfully submitted,

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